Soils and Pond Building

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Outline

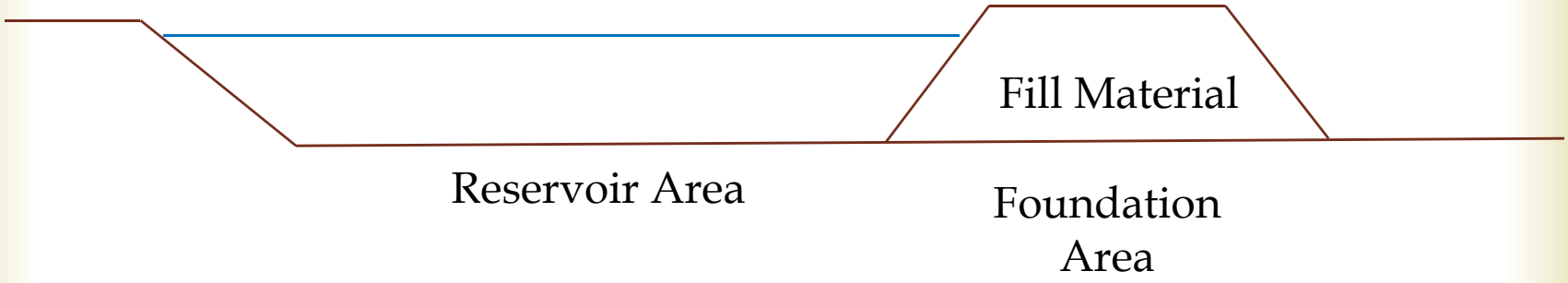
- General outline of ponds to be constructed
- On-Site Investigations
- Overview of what data/soil properties are necessary
- Internet sources for a preliminary soils investigation

Soils and Pond Building

- Two basic types of ponds we are interested in:
  - Embankment ponds
  - Excavated ponds

- Associated soil properties of interest differ depending on which type of pond is desired.

Embankment Ponds



- Embankment ponds can be either:
  - Inline (intercepts stream flow)
  - Offline (removed from stream channel)

Excavated Ponds

- Surface-fed ponds
- Groundwater-fed ponds
- Or a combination of the two

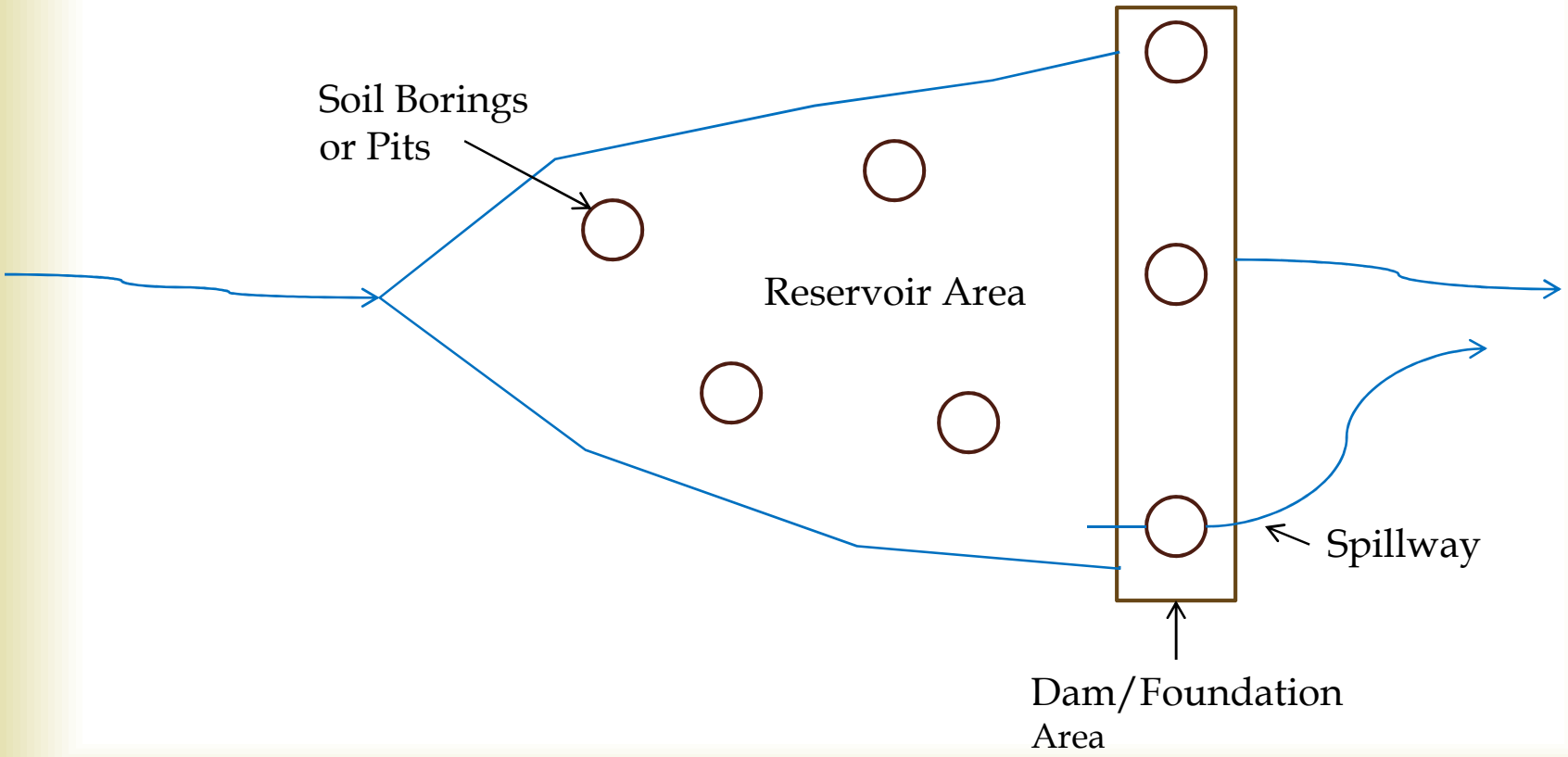
On-site Investigation

- Both types of ponds require a site specific soils investigation
- The Field Investigation:
  - Need 3-4 borings/acre, where soils are relatively uniform
  - Complex areas may require more
  - Need to dig deep enough to see what is below the final grade of the ponded area

On-site Investigation

- Need thorough investigation of center-line of the dam and spillway
- Boring(s) need to be 1.5x deeper than the height of the dam
- If foundation is rock:
  - Ensure there are no steep drop offs of the rock surface below dam
  - Ensure rock is free of fissures or seams
- Investigate the abutments of the dam

On-site Investigation



Soil Types

- Soils in the reservoir area

- Soils in the foundational area and as fill material for an earthen dam

Soils in the Reservoir Area

- Pond site suitability depends on the ability of the soils in the reservoir area to hold water.
- Need:
  - A relatively impervious layer
  - Ideally, about 36 inches thick (for depths <10’)
  - When dealing with compacted clay liner, minimum of 1’ thickness of compacted soil material.

Soils in the Reservoir Area

Preferred Soil Types

- Clays and silts
  - clay, clay loam, sandy clay loam, sandy clay, silty clay
- Some silty and clayey sands and gravels
  - silty clay loam, sandy loam (↑ clay content)

Problematic Soil Types

- Coarse-textured sands and sand-gravel mixtures
- Sandy Loam, Loam, Silt Loam, Loamy Sand, Sand
- All peat, muck, and mineral soils with high organic matter content

Soils for Fill and Foundational Areas

- Materials suitable for the foundation and embankment fill must provide both stability and imperviousness.
- Material needs to be:
  - Strong enough to remain stable
  - Tight enough to prevent excess or harmful seepage when compacted
- Should come from on or near the pond site

Soils for Fill and Foundational Areas

- Suitable soils are usually constituted of a mixture of fine and coarse grained particles
- The best material is:
  - Fine gravels or coarse sand to fine sand with clay in the optimal proportion (≈20% clay by weight)
- Material to avoid:
  - High shrink/swell clays
    - They are dispersive, unstable and prone to failure

Soils for Fill and Foundational Areas

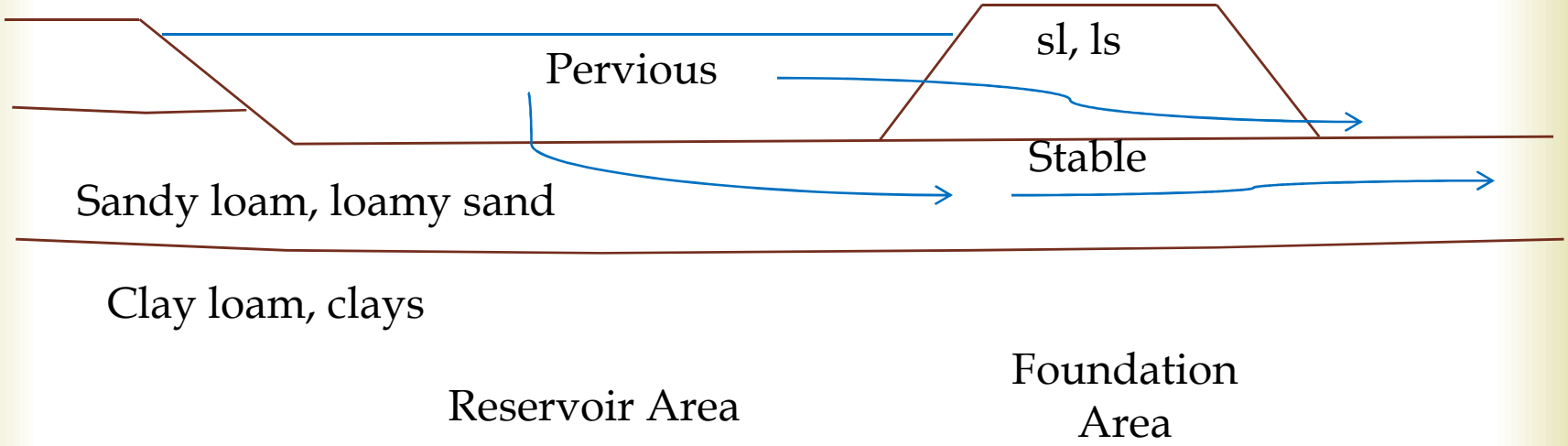
Preferred Soil Types

- Sandy clay loam, sandy loam (↑ clay content)
- OK for small ponds:
  clay loam, clay (lean), loam, sandy clay, gravelly clay, silty clay, silty clay loam,
- Sandy loam, loamy sands if an impervious seal or core is provided to limit seepage

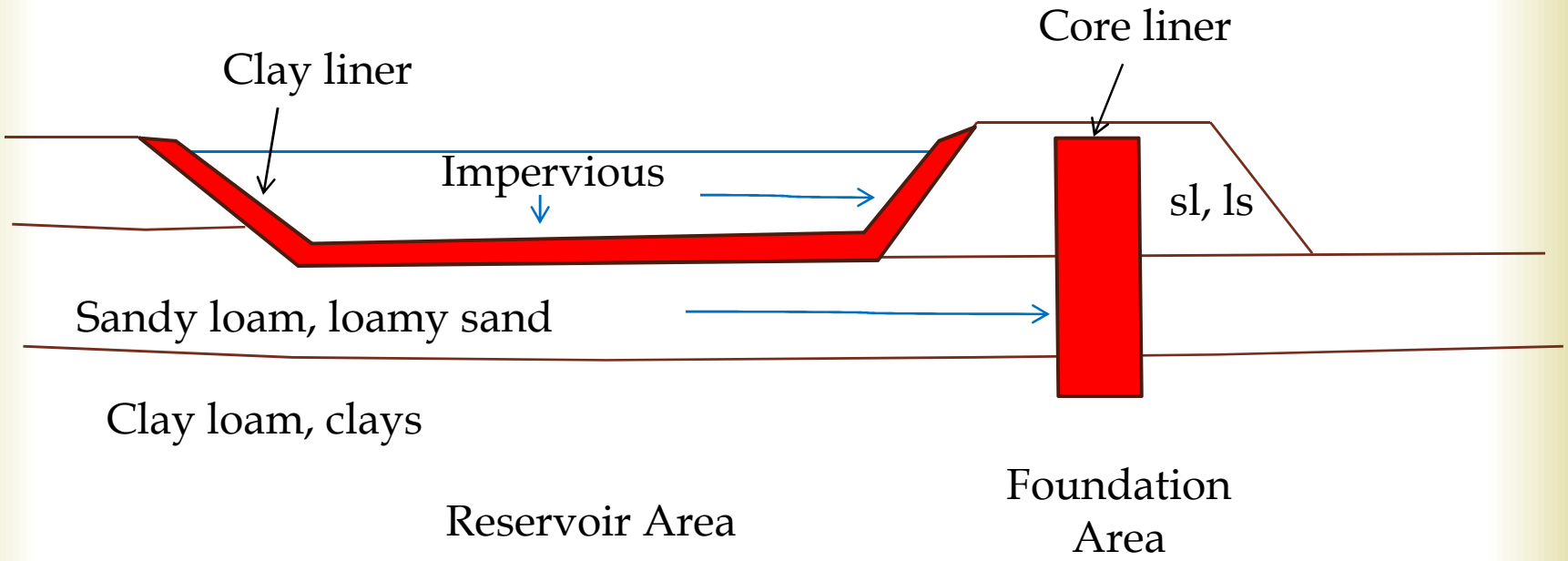
Problematic Soil Types

- High shrink/swell clays
- High silt content soils (must maintain proper water content for adequate compaction)
- Sandy loam, loamy sands, sands, fine gravels (without an impervious seal or core)

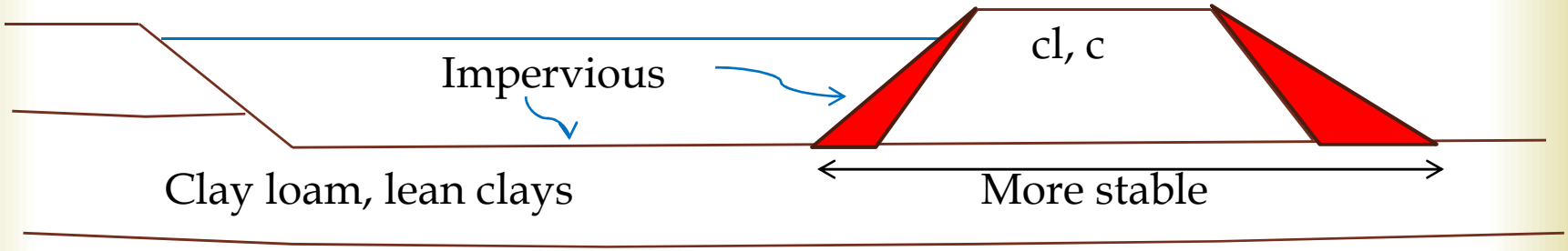
Embankment Ponds



Embankment Ponds



Embankment Ponds



Sandy loam, loamy sand

Reservoir Area

Foundation Area

Soils and Surface-Fed Ponds

- Most desirable sites have:
  - Fine-textured clay or silty clay that occupies the bottom of the pond in a thick layer
  - Other mixed textures will work as well
- Sites to avoid:
  - Coarse-textured sands and sand-gravel mixtures
  - These textures may need a liner
  - Shallow depth to fractured or unstable bedrock

Soils and Groundwater-Fed Ponds

- In North Carolina, ponds dependent on a seasonally high water table (SHWT) should also look for surface waters to keep them filled.
- Ideally, the maximum distance between the ground surface and the water surface is never greater than 6 feet.
- Evaluations of any ponds at least partially dependent on groundwater are best evaluated during the summer months when the water table is low.

Estimating Storm Runoff

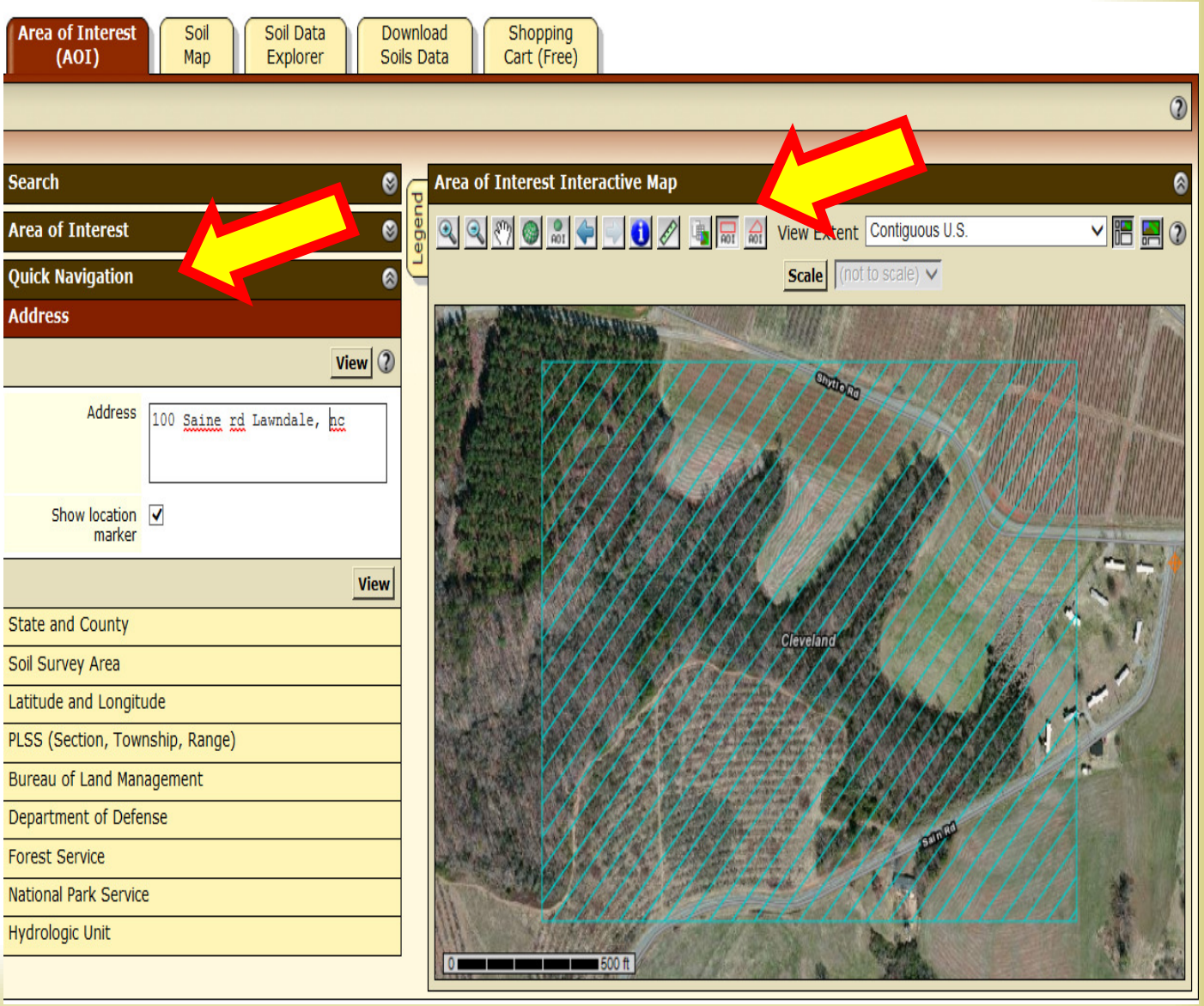
- Depends on the amount of precipitation, vegetative cover, size of the watershed, slope of the land, and the soil type
- Hydrologic Groupings of Soil
  - A – Deep, well-drained, high infiltration, low runoff, sandy soils
  - B – Mod. Deep, well-drained, moderate infiltration
  - C – Slow infiltration when wet, finer textured
  - D – Very slow infiltration, clayey, high runoff

Getting Soils Information

- The easiest ways to find relevant soils information is to use the following free software:
  - Google Earth Enterprise Client
  - USDA Web Soil Survey
- Other options include other GIS software, for example:
  - ESRI ArcMap
  - County specific online GIS via web browser

Using Web Soil Survey

- Navigate to your site location using the 'Quick Navigation' menu
- Define your area of interest (AOI) using the toolbar



Using Web Soil Survey

- Minimum properties to check using 'Soil Data Explorer':
  - Suitabilities and Limitations for Use tab:
    - Water Management:
      - Embankments, Dikes, and Levees

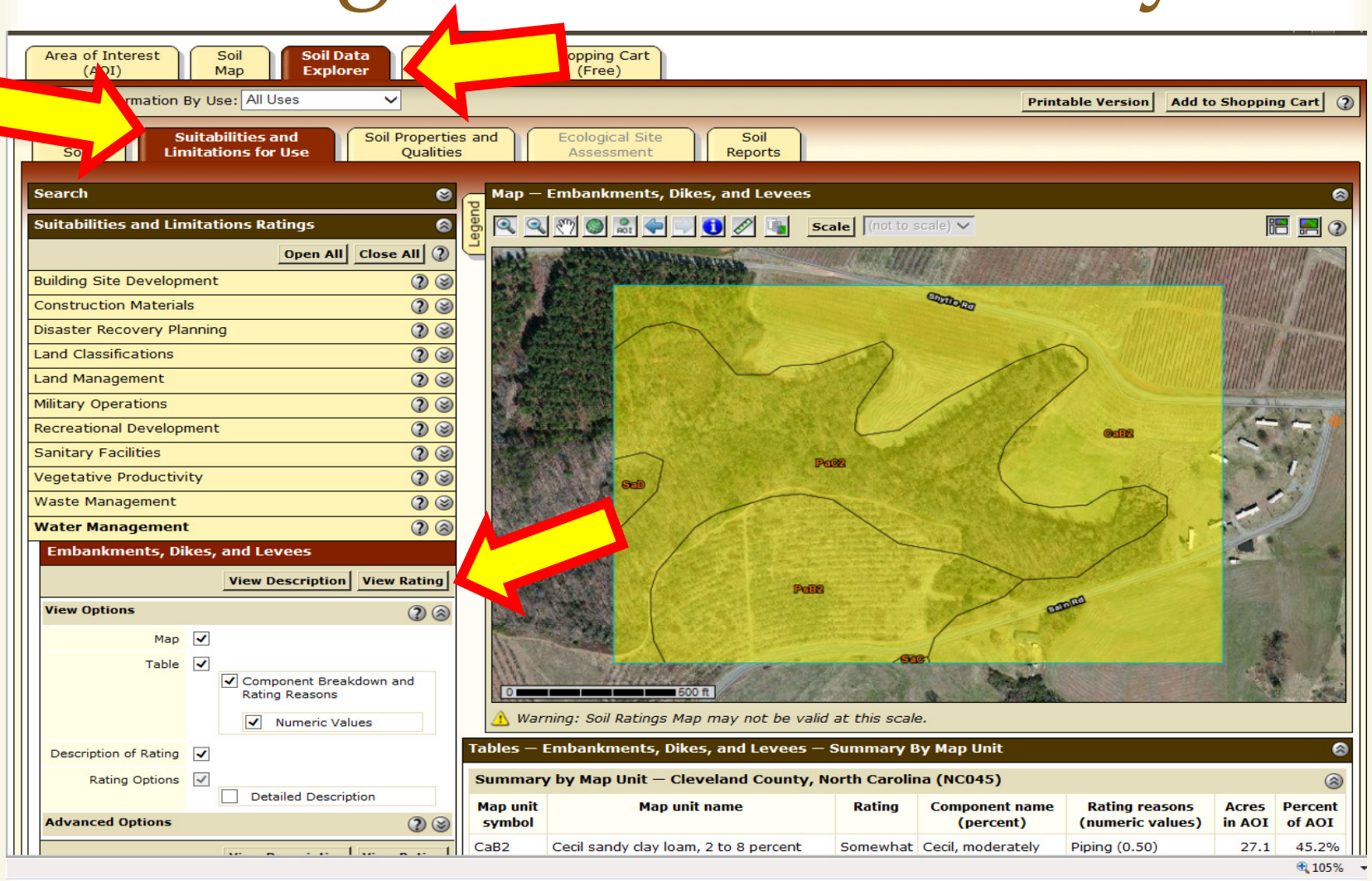
      → For constructed embankment ponds see also:

        - Pond Reservoir Areas

      → For excavated ponds see also:

        - Excavated Ponds (Aquifer-Fed)

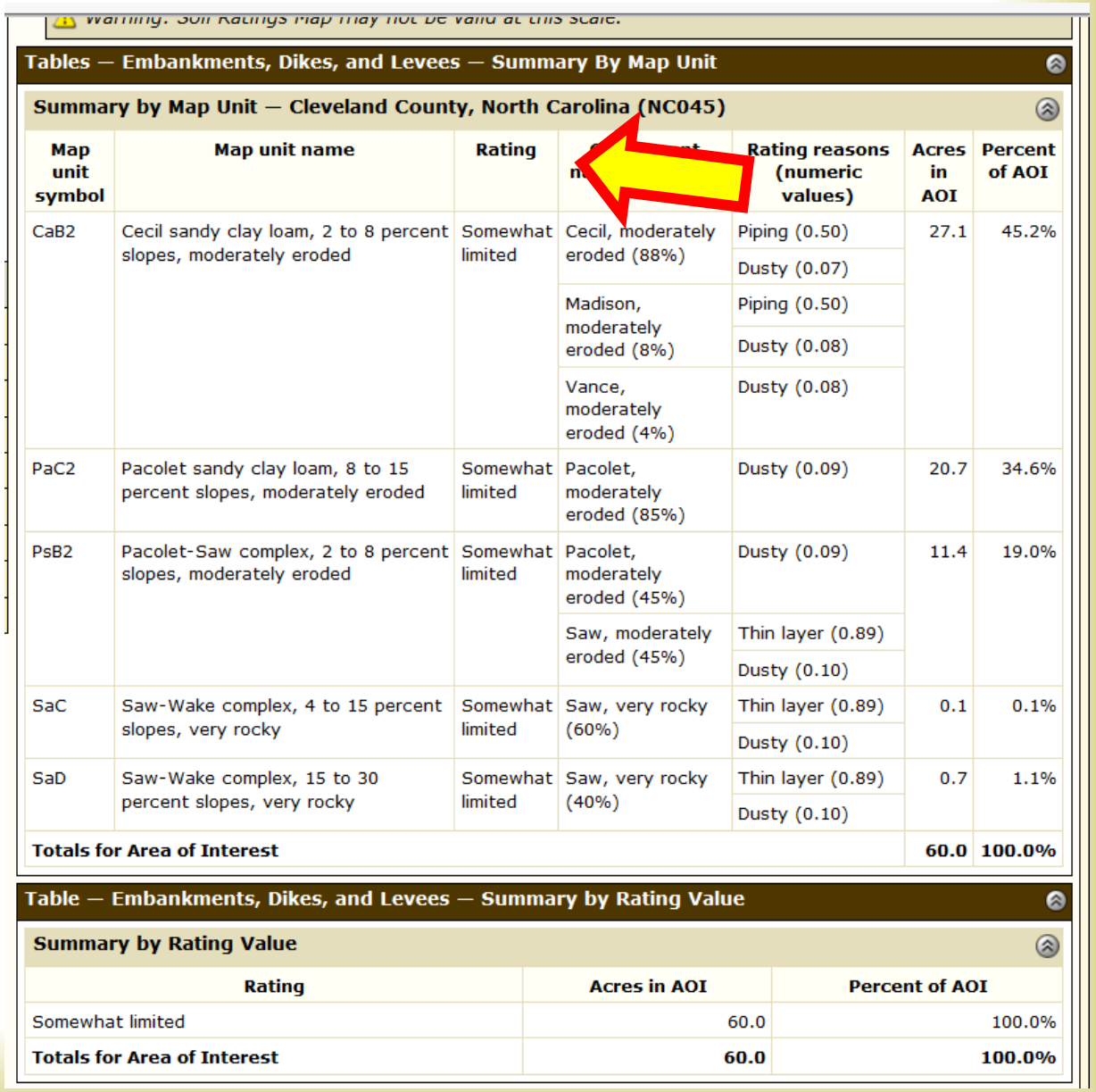
Using Web Soil Survey



- Select ‘View Rating’ to produce thematic map

Using Web Soil Survey

- The rating system ranks selected soils as
  - Not limited
  - Somewhat limited
  - Very limited
- Each rating also has a degree of limitation from 0.01 (least limiting) to 1.00 (most limiting)



Warning: Soil Ratings Map may not be valid at this scale.

Tables — Embankments, Dikes, and Levees — Summary By Map Unit

Summary by Map Unit — Cleveland County, North Carolina (NC045)

Map unit symbol	Map unit name	Rating	Component name (percent)	Rating reasons (numeric values)	Acres in AOI	Percent of AOI
CaB2	Cecil sandy clay loam, 2 to 8 percent slopes, moderately eroded	Somewhat limited	Cecil, moderately eroded (88%)	Piping (0.50)	27.1	45.2%
				Dusty (0.07)		
			Madison, moderately eroded (8%)	Piping (0.50)		
				Dusty (0.08)		
			Vance, moderately eroded (4%)	Dusty (0.08)		
PaC2	Pacolet sandy clay loam, 8 to 15 percent slopes, moderately eroded	Somewhat limited	Pacolet, moderately eroded (85%)	Dusty (0.09)	20.7	34.6%
PsB2	Pacolet-Saw complex, 2 to 8 percent slopes, moderately eroded	Somewhat limited	Pacolet, moderately eroded (45%)	Dusty (0.09)	11.4	19.0%
			Saw, moderately eroded (45%)	Thin layer (0.89)		
				Dusty (0.10)		
SaC	Saw-Wake complex, 4 to 15 percent slopes, very rocky	Somewhat limited	Saw, very rocky (60%)	Thin layer (0.89)	0.1	0.1%
				Dusty (0.10)		
SaD	Saw-Wake complex, 15 to 30 percent slopes, very rocky	Somewhat limited	Saw, very rocky (40%)	Thin layer (0.89)	0.7	1.1%
				Dusty (0.10)		
Totals for Area of Interest					**60.0**	**100.0%**

Table — Embankments, Dikes, and Levees — Summary by Rating Value

Summary by Rating Value

Rating	Acres in AOI	Percent of AOI
Somewhat limited	60.0	100.0%
Totals for Area of Interest	**60.0**	**100.0%**

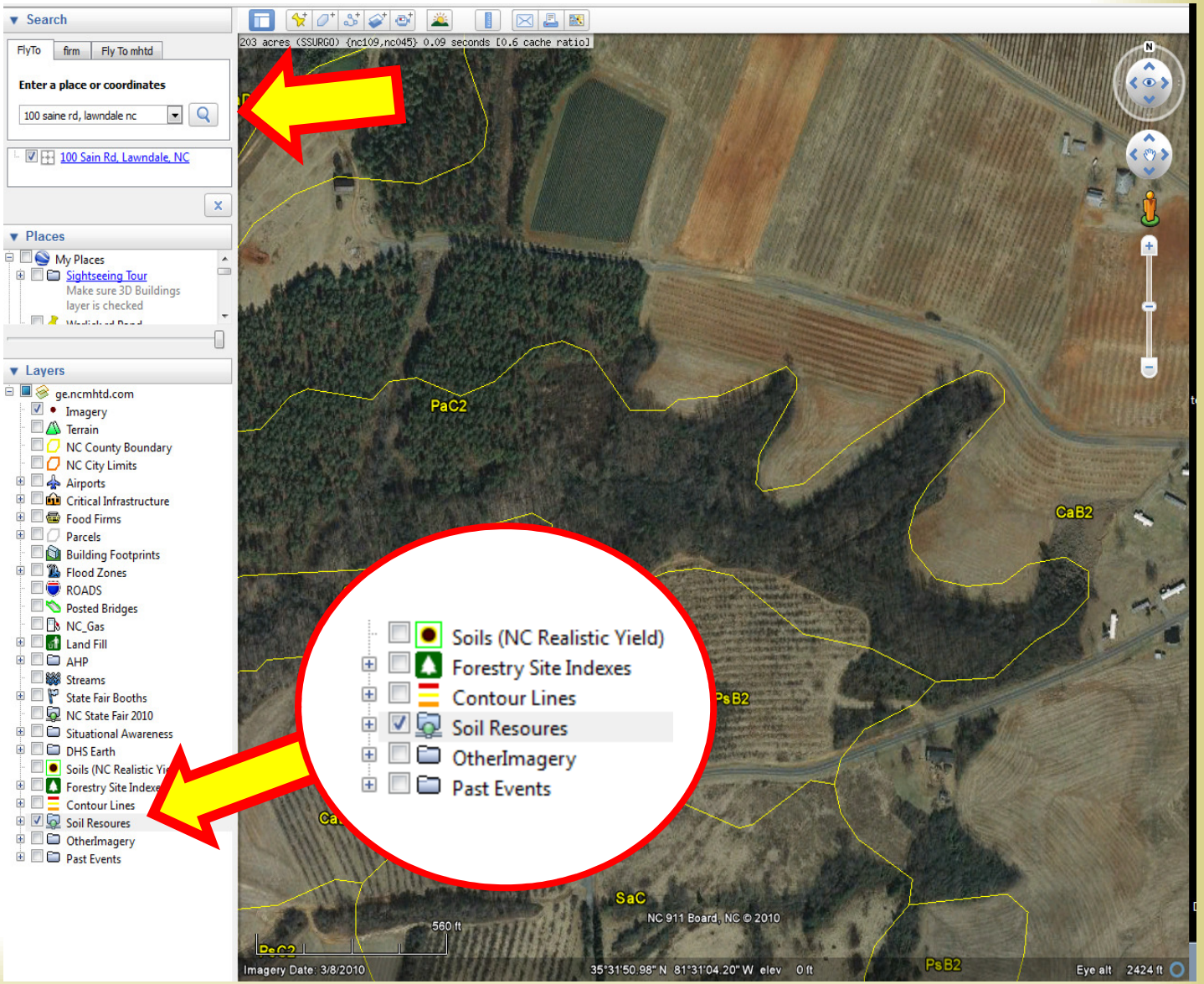
Using Web Soil Survey

- Sites listed as ‘Very limited’ and with high numerical ratings can impose potentially unworkable technical difficulties.

- These sites would require in-depth onsite investigations

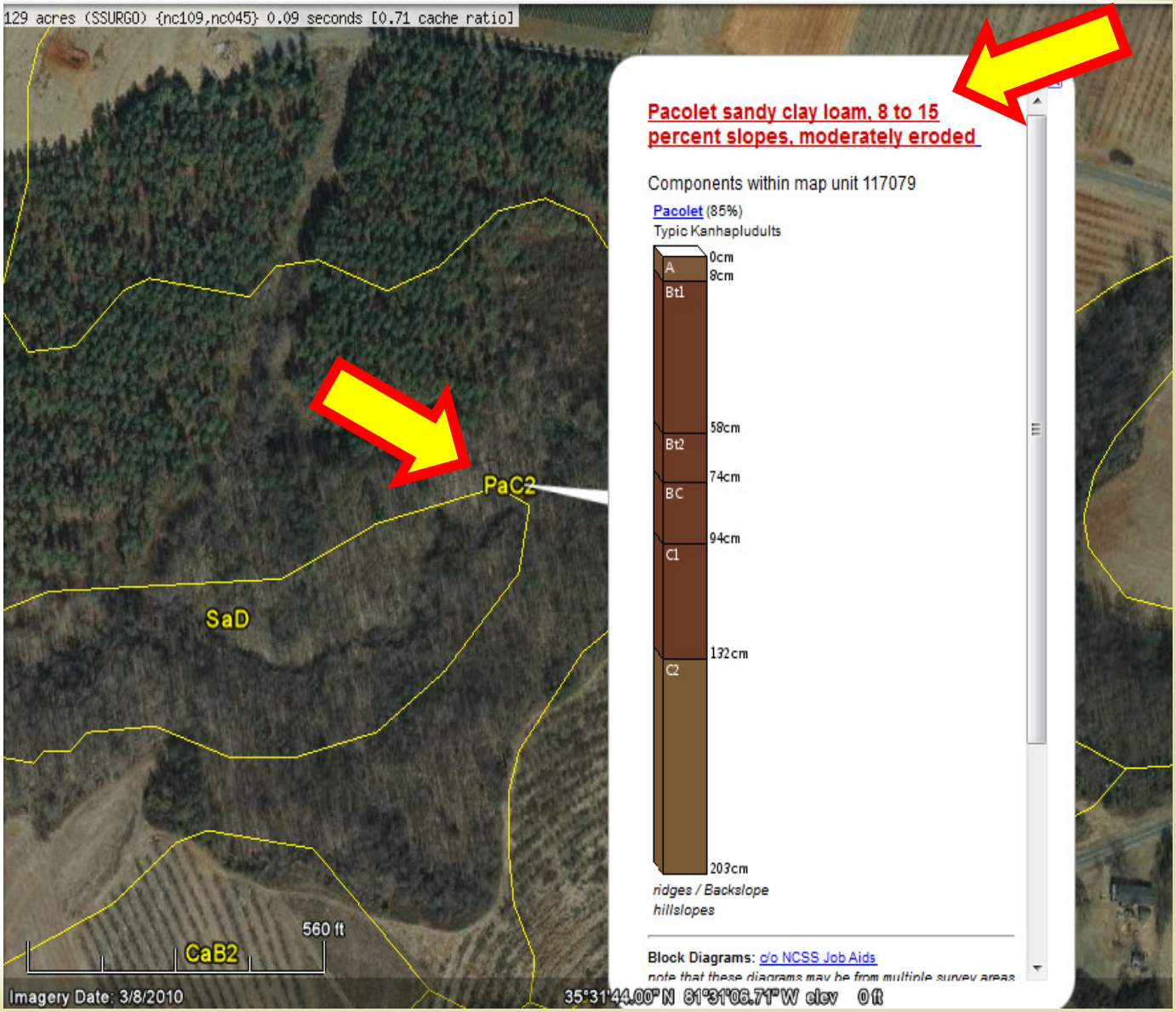
Using Google Earth EC

- Navigate to your site location using the 'FlyTo' menu
- Select 'Soil Resources' layer from the 'Layers' menu

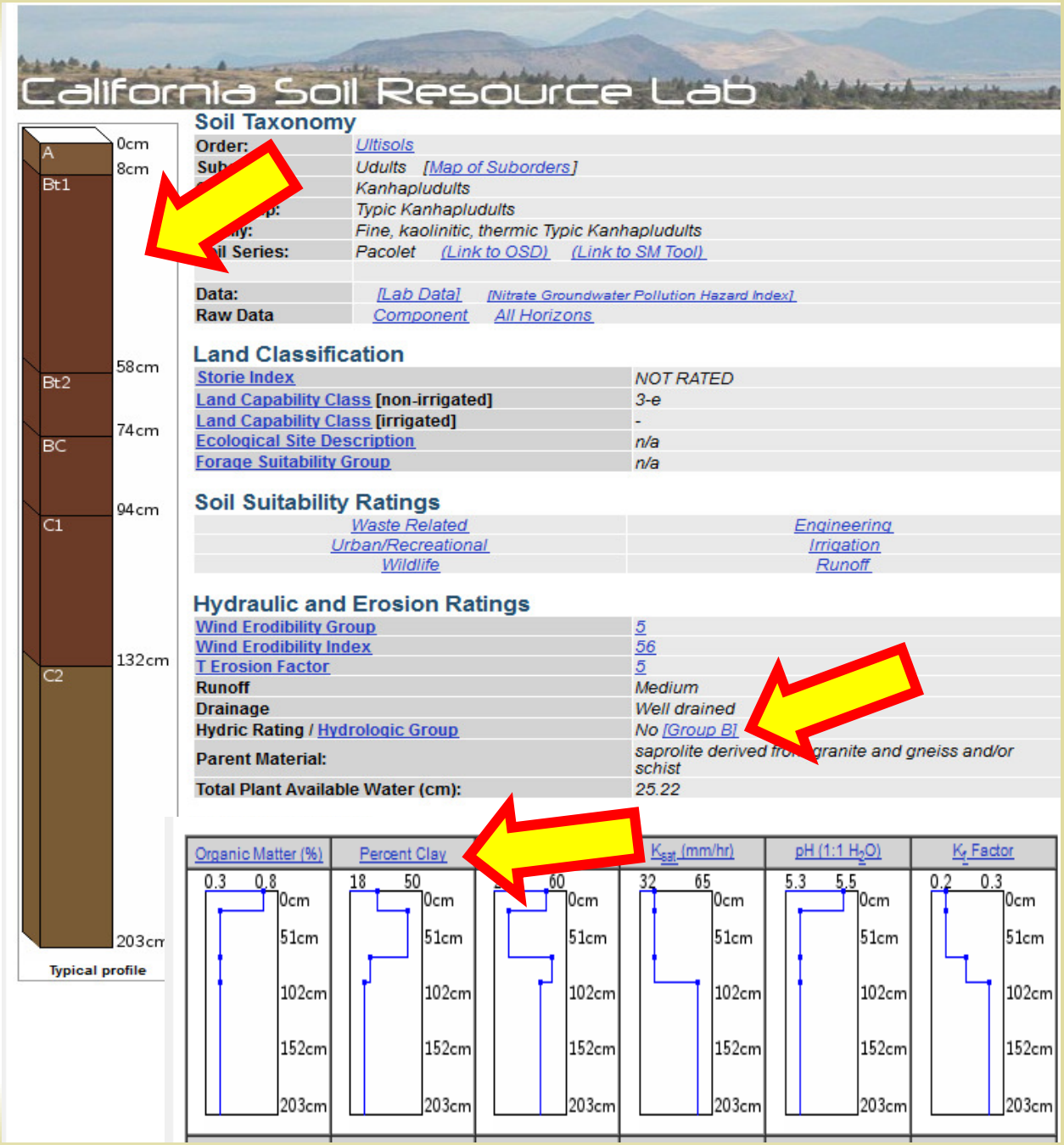


Using Google Earth EC

- Select the map unit symbol for the soil of interest
- Select the map unit description title in the pop-up box



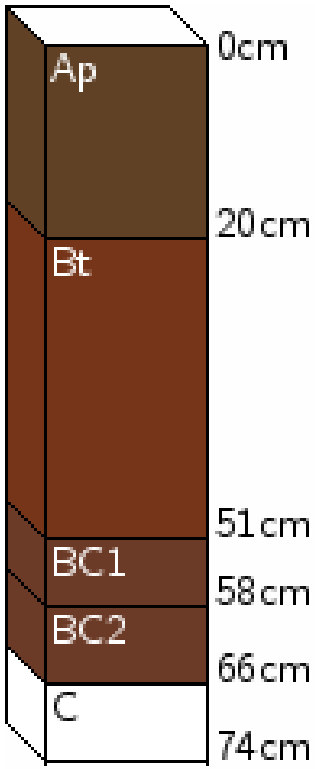
- Pertinent information at a glance:
  - Typical profile
  - Hydrologic group
  - Percent clay



Using Google Earth EC

- Potential warning signs of unsuitable site:

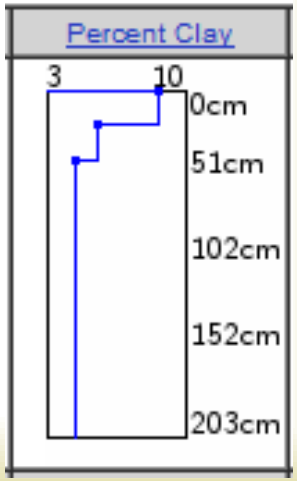
- Shallow soil profile



- Rapidly permeable soils (ideally group C or D)

Drainage	*Moderately well drained*
Hydric Rating / Hydrologic Group	*No [Group A]*
Parent Material:	*cobbly and gravelly alluvium*

- Low clay content (ideally ~30% or greater)



WSS vs. Google Earth EC

- Web Soil Survey (WSS) is an official site of the USDA-NRCS National Cooperative Soil Survey
  - WSS is linked to the most recent publicly available data in the SSURGO database
- The soils information on Google Earth EC is provided by the California Soil Resource Lab.
  - The CSRL database is an independently maintained version of the official SSURGO database
  - The CSRL database is periodically updated from the official SSURGO database
- Ideally, all pertinent information should be reasonably measured on site to ensure accuracy. If there is a conflict, always refer to the WSS for the most up to date publicly available data